were so many of these small, young individuals that an estimate in the thousands per acre would not be an exaggeration.

It must be admitted that the temptation is great to interpret the fluctuations in the mollusk populations in the Estero de Punta Banda as a direct consequence of the poisonous or otherwise detrimental effect of the Red Tide of 1958. Yet a careful consideration of all the facts presented as well as those merely alluded to (I am referring here to the other species of Group 6 not discussed in detail, as unnecessary duplication was avoided) seems to point inevitably to other factors as responsible for the phenomenon. The outer portion with the much freer flow of water during the changing of the tides should have recovered completely, or at least almost so, by 1960. In the inner portion, where the tidal changes seem to be less complete, the deleterious effect of the Red Tide might have made itself felt for a much longer time and furthermore, the recovery rate might have been considerably slower. Yet just the reverse seems to be the case. Seasonal fluctuations in environmental conditions can almost certainly be ruled out as responsible for the differences between the inner and outer portion. Reproductive cycles cannot be held responsible in the case of Chione since the presence of large and small individuals (see again Figures 1, 2, and 3, Plate 4) tends to support the view that this species has a more or less continuous breeding season. At this time, it seems only safe to say that these fluctuations have been observed but that their connection with the Red Tide is not demonstrable beyond the fact that they occurred after the Red Tide and, further, that the real factors responsible might be uncovered only through a continued study — which I hope may be carried on.

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The Riddle of the Bivalved Gastropod

by
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Early last November I was one of several guests of the Belvedere Scientific Fund on a trip to the La Paz area, Gulf of California. At a cove near the northwest corner of Espiritu Santo Island we found some unusually rich beach drift. Sorting this later, I found a single valve of what seemed to be the erycinid pelecypod, Scintilla? chloris Dall, but I noted one distinctive feature, a spiral nucleus that recalled figures of an Australian bivalve, Edenttellina.. Shortly thereafter came a paper by two Japanese workers, Kawaguti and Baba (1959), announcing discovery of an opisthobranch gastropod with a two-valved shell. Their figures could almost have been of the little shell I had. This was something to stir one's pulse! The implications started a flurry of letters between interested persons in four countries, as we compared notes and brought new evidence to light, some of which has by now been published (see References).

Dr. Siro Kawaguti, of Okayama, Japan, collected the first specimens of Tamanovalva limax — as it was to be called — in August, 1959. Collaborating with Japan's foremost specialist on opisthobranchs, Dr. Kikutaro Baba, he published a brief account with description of the form as a new genus, new species. The soft parts were definitely those of a gastropod. The salient characteristics of the bivalved shell were the spiral nucleus in one valve, greenish coloration, and a single subcentral muscle scar. Kawaguti and Baba mentioned the Australian form Edenttellina, but, assuming it to be a pelecypod, made no direct comparisons. In two subsequent papers Kawaguti has given additional information on the habits and the life history of Tamanovalva, which he has been able to culture successfully. He has, in fact, recently informed me, by letter, that he now has in his aquaria "children and grandchildren" of the original material.

Two British colleagues, Drs. L. R. Cox and W. J. Rees, realizing the importance of the Japanese discovery and fearing that the journals in which it was reported would be of limited circulation, published an essay-review in the British Nature (Cox and Rees, 1960). They pointed out the strong resemblance of Tamanovalva to the figures of the Australian Edenttellina and urged a search for living specimens of the latter, which as yet were unknown. A few days before their paper appeared in print in England, an Australian collecter, Mr. Robert Burn (who had already been alerted by correspondence as to the probable habitat in which to search), succeeded in finding Edenttellina alive. As predicted, it turned out to be an opisthobranch gastropod (Burn, 1960). Not only does Edenttellina inhabit exactly the same niche as Tamanovalva, on the roots and tips of the green alga Caulerpa in tide-pools at low tide level, but it has all of the other distinctive features. Tamanovalva thus becomes a synonym of the earlier Edenttellina Gatliff and Gabriel, 1911. However, the picture has further complications.

Hedley (1920), an Australian malacologist, had pointed out that some of the forms from the Eocene in the Paris Basin bear a close resemblance to the Australian Edenttellina. He had, in fact, employed the name Ludovicia for the Australian shells before the name Edenttellina had been proposed. Ludovicia had been validated by Cossmann in 1888 from a Deshayes manuscript but was not used widely because many workers thought it to be a homonym. Cossmann also proposed the name Anomalomya in 1888 for a very similar shell. Earlier than either of these is Berthelinia Crosse, 1875. Published figures of Berthelinia show well the spiral nucleus and the single muscle scar. I have had the good fortune to see some specimens in the University of California collection and can testify that these shells, from Middle and Upper Eocene horizons in France, are distinguishable from the Recent Japanese form only in minor details of outline. Therefore, it seems fairly conclusive that Tamanovalva is a synonym not only of Edenttellina but also of Berthelinia. Although all of these four earlier-named genera have been allocated to various families in the Pelecypoda, one notes with interest that Crosse, when describing Berthelinia, thought it might be a gastropod, near Capulus. Later, Crosse and Fischer (1887), finding opposite valves, reassigned the genus to Pelecypoda, in the family Prasinidae (now known as Juliidae). Cossmann, too, was aware of a gastropod resemblance in Ludovicia, which he placed in Galeommidae; he said he would have called it a gastropod if he had not seen the two valves. Hedley remarked on Edenttellina that he would otherwise have considered it the internal shell of an opisthobranch. How near he was to the truth! The genus is, however, classified in Juliidae by modern authors. Cossmann placed Anomalomya here, too, under the earlier family name Prasinidae.

The question now arises, what points of resemblance are there between the Berthelinia complex and the rightful members of Juliidae? The family is a small one, both in size of shell and in number of taxa, with — otherwise — only one genus, Julia Gould, 1862 (synonym, Prasina Deshayes, 1863) and nine named species. The geologic range is from the Miocene (Europe, the Caribbean, and the East Indies) to the Recent. Beets (1944), in a review of Julia, shows that it now ranges, in the tropics, from East Africa to Polynesia. A West American species, J. equatorialis, was described by Pilsbry and Olsson in 1944, and Howard (1951) suggested that the type species, J. exquisita Gould, might range from Hawaii to West Mexico. In outline the shell is more heart-shaped than that of Berthelinia. The hinge in one valve has a socket, in the other a large, blunt tooth. Most shells are greenish in color. In some species a small spiral nucleus has been noted on young specimens. The muscle scar is central, but it is not a single circular scar. Rather, it is composed of two parts that are hourglass-shaped in some specimens, in others completely divided into two parts, one above the other. No living specimens of Julia have been reported as yet, so that the soft parts are unknown. However, it seems to me that there is a very good chance they will prove to be similar to those of Berthelinia. My conviction is strengthened by Mr. Burn's discovery — simultaneously with the living Edenttellina — of a second bivalved opisthobranch, which he will soon describe as a new genus, having a muscle scar pattern different from that of Berthelinia. This suggests to me considerable plasticity in the group; hence, I feel the more certain that when Julia is found living,

it will prove to be a gastropod. If so, we shall have the novel opportunity of moving not just a genus but a whole family from Pelecypoda to Gastropoda.

To return to the single specimen that came to light in the Espiritu Santo Island drift: It has the greenish color, the form, the spiral nucleus, and the muscle scar of Tamanovalva -- i. e., Berthelinia. One cannot, of course, completely rule out my first identification of Scintilla? chloris until specimens are actually compared with Dall's type, but some notes given me by Dr. Woodring, who has re-examined the type material, increase the likelihood that the new find represents an unnamed species of Berthelinia. Naturally, one is eager to return to Espiritu Santo and make a determined search in the tide-pools for the living animals. Prospects for a double reward are good, for in the sample of beach drift that yielded the one valve of Berthelinia there were three valves of a Julia. Beet's distribution map shows that the range of Julia can overlap the range of Berthelinia at only a few places. The La Paz area is therefore strategically situated. All evidence in the literature suggests that both genera occupy much the same habitat — green algae just at or just below the low-tide level. Here, then, is an opportunity to whet any collector's enthusiasm. Finding the actual animals, however, will not be an easy task, for the shells are only about 3 mm. in length, and the tiny green animals are said to be extremely hard to see on their chosen forage plant, Caulerpa.

ACKNOWLEDGMENTS

I wish to express my appreciation for the opportunity afforded me by the Belvedere Scientific Fund. A word of thanks is due also the members of the shell-collecting party, especially to Mr. Allyn G. Smith, who sacked up the drift material that yielded the valves of Berthelinia and Julia. Dr. Siro Kawaguti has supplied not only reprints of his papers but a color slide of Tamanovalva, and Dr. Kikutaro Baba has sent both literature and two specimens in alcohol. Mr. Edwin Allison made available for study the fossil specimens of Berthelinia in the University of California collection. To the several correspondents who each contributed some piece of information I am also grateful — Mr. Robert Burn, Mr. B. C. Cotton, Dr. L. R. Cox, Dr. Nell Ludbrook, Dr. Hope MacPherson, and Dr. W. P. Woodring.

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